AN INVENTORY AND ANALYSIS OF HIGHER EDUCATION FACILITIES IN THE COMMONWEALTH OF MASSACHUSETTS

UPDATE REPORT OF THE FACILITIES INVENTORY PROJECT
JUNE, 1973

PREPARED FOR THE MASSACHUSETTS HIGHER EDUCATION FACILITIES COMMISSION

EDUCATIONAL MANAGEMENT ASSOCIATES, CAMBRIDGE, MASS.

AN INVENTORY AND ANALYSIS OF HIGHER EDUCATION FACILITIES IN THE COMMONWEALTH OF MASSACHUSETTS

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This report marks the fourth year of operation of the updated Massachusetts facility inventory. Our goal is evaluating the current allocation of educational resources and predicting how these resources must be increased and reallocated to meet future needs. To be valid, such inferences must rely on a comprehensive and current description of existing resources -- the updated facilities inventory.

The inventory is based on variables of supply and distribution; only in a limited way do we touch on problems of demand.$\underline{1/}$ Examining such variables can be of immense value -- if we ask the right questions of our data. The first step in doing this has been to order our description of physical facilities in terms of five basic questions:

1.   What is the size of the particular educational facility?

2.   What is its function?

3.   What is its physical construction or <u>design</u> <u>characteristics</u>?

4.   What are the <u>dates</u> of its construction or rehabilitation?

5.   How much did it <u>cost,</u> how was it payed for, and how much is it worth today?

We have answered these questions for virtually every building used for educational purposes in the Commonwealth of Massachusetts.

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$\underline{1/}$ We have integrated some basic enrollment figures with the facilities data.

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We went further, asking more complex questions about relationships and trends among these variables. This analysis can be directly relevant for various members of a planning team.

For instance:

The economic planner at federal, state, or local levels may want to see how much has been invested in specific types of facilities during the last thirty years. He can find trends in different types of investment, changes in utilization, and depreciation of value. He may derive a more objective view of the consequences of different levels and kinds of investment.

The designer may focus on trends in construction. In conjunction with his own criteria he can, for example, assess the relative value of renewal versus new construction and present his clients with a clear set of alternatives given their specific problems.

The local university administrator can look at the distribution of resources within his school and between his and comparable institutions. He can use this information to evaluate requests from departments; to plan to emulate or avoid trends in other institutions; to communicate in general, comprehensive terms with potential sources of funding.

It should be clear that the value of the inventory goes beyond the vast sum of information it contains. It is a system for organizing information and a tool for using it. We have designed it to grow -- to receive and to classify new data. We have analyzed this data so that it is relevant and useful for a variety of planning needs and perspectives. Yet our analysis is simply a model, one set of inferences that can be drawn from the data. Other trends will be revealed to those who think of and ask the right questions.

In 1966, the United States Office of Education initiated a national study of higher educational facilities on a state by state basis. The Massachusetts Higher Educational Facilities Commission conducted that study for the Commonwealth of Massachusetts. A joint advisory committee was established to guide planning terms, to reflect diverse institutional needs, and to recommend appropriate actions and decisions to the Higher Education Facilities Commission.

To complete its inventory, the Massachusetts Facilities Inventory Project followed manuals and guidelines issued by the United States Office of Education. The goal of the study was to obtain as much information as possible about all buildings and all rooms of every college and university in each state.

Data concerning buildings included:

Building Name

Building Number

Gross Square Feet

Ownership

Date of Initial Occupancy

Estimated Value of Building

Condition of Building

Source of Funds

Actual Capital Investment

Assignable Square Feet

Custodial Square Feet

Circulation Square Feet

Mechanical Square Feet

Construction Square Feet

Furnishing Cost

Type of Cooling System

Type of Construction

Degree of Graduate Program

Location

Number of Floors

Year Renovated

Year Constructed

Year to be Demolished

Fall Out Shelter Rating

The data concerning rooms within each building included:

Building Number

Room Number

Subject Type

Room Type

Net Assignable Square Feet

Number of Stations

Percent Used for Research

Early in 1968, the Massachusetts Higher Education Facilities Commission contacted ninety-six college and university presidents throughout the state to inform them of the upcoming study, and asked each of them to select an institutional representative to work closely with the Facilities Inventory Project Staff (FIPS). In establishing the inventory the schools were asked to fill out two sets of forms: a Building Characteristics Form and a Room by Room Characteristics Form, both providing the information required by USOE. The data was edited, coded, and processed to create the first facilities inventory in 1969. The output was of essentially the same format as that in this year's report; we have made only a few changes in structure and programming. During this same time FIPS developed a space utilization study, a companion piece to the inventory that investigates the actual use educational facilities receive.$^{2/}$

During the analysis of the FIPS data the update work was begun. In addition to the two original forms schools were asked to fill out a Deletions Form, listing demolished rooms and buildings, and a Correction Form, listing specific required changes in the data input. We found it a considerable advantage in accuracy and time to have the cooperation of the same personnel at each college in gathering the data as last year. Their

2/ A Study of Space Utilization in Higher Education Facilities in Massachusetts, April, 1971, Educational Management Associates.

help, and the fact that the yearly updating process guarantees familiarity

with the inventory procedure, made our field work simpler, allowing us

to concentrate on imporving the program and output format. More

schools participated in the updating process this year, making the report

more comprehensive.

This section describes the summary listings, matrices, and correlations.   Each participating institution received a listing of input data (the Data Edit and Validation Report) and a set of derived data materials generated by the Listing and Matrix programs.   These programs also produced outputs on the State level, the summaries of which more than duplicate those available on the Campus level.   In addition the plot program produced a series of Statewide correlations.

Campus Level - Part I: Data Edit and Validation Report

Part I contains all inputs used to generate campus level matrices and statewide matrices and correlations. Section A of Part I presents information for each building of participating institutions, and Section B displays data for each room within the building.

The institution's number and name appear on the first line of Section A. This identification is followed on the same line by an indication of the type of school according to two federal codes: from I through V to show the level of training provided and from A through K to show the type of program offered. The last datum on this first line shows the number of full time graduate and undergraduate students enrolled at the institution in question as of Fall, 1968.

The second line contains the number and name of the building for which the succeeding data have been collected.

The third line contains six major headings under which appear various date relating to the building identified on the second line. Four kinds of information are shown under the first heading, functions: ownership, degree to which the building is used for graduate programs, type of professional school that the building serves (if any), and the building's location.

Under history, the second heading, appear four other kinds of information: the year in which the building first was occupied, the year in which it was con- structed, the year of its most recent

rehabilitation and/or modernization, and the year in which it is scheduled for demolition (if any). Five kinds of data appear under design; they are type of construction, number of floors, condition, status of fallout shelter according to the National Shelter Survey, and percentage of building that is air-cooled by means other than fans.

The last three major headings include information about costs, area, and funding. Under investment appear the cost of the building (including all investment after construction), the cost of equipment contained in the building, and the building's current estimated insurable value. The appropriate figure is shown beneath the gross square feet heading. Finally, the sources of funding for construction and the amount of funding from each source appear under source of funds.

Printed directly below Section A, Section B is an extensive room-by-room facilities inventory that lists information for every kind of room, including non-assignable areas like halls and spaces required by the building's frame. All the information for each room appears on one line and is divided by six headings. An unique number, supplied by the Facilities Inventory Project when necessary, is printed under room number. Three data appear beneath organizational unit - the institution's name for the unit (Business Office, French Dept., Dormitory, etc.), the institution's code for that unit or room (if any), and the organizational unit-subject field code.

Two kinds of information are listed beneath room type. They

are the institution's designation for that room type (dorm room, laboratory, office, etc.) and the room type according to codes for either assignable or non-assignable area. The appropriate number appears under number of stations (seats, beds, carrels, etc.), net assignable square feet (NASF), and percentage of research to which the room is devoted.

Below the last line, which corresponds to the last room in the inventory of a particular building, is printed a figure that represents total assignable area for the building.

Both Sections of Part I are continued to cover every one of the institution's buildings. Beneath the complete data for the last building a figure is listed for total net area this institution.

Campus Level - Part II: Listing and Matrix Summaries

Part II contains various matrices based on the campus-by-campus data listed in Part I. The first matrix - <u>Data Breakdown by Organizational Unit and Subject Field Code (detailed) versus Room Type</u> - is given for every building on campus. It is detailed for Organizational Unit and Subject Field Code (codes 1110, 1520, etc.) and general for Room Types (100, 200, etc.). Every cell - the intersection of every row going across and every column going up and down - contains the number of rooms that satisfy the requirements for that cell, NASF for those rooms, the ratio of that NASF to the building's total NASF, the number of stations that satisfy the cell's requirements, the ratio of NASF to stations, and the standard deviation for that ratio. The last column contains combined figures for all Room Types of a particular Organizational Unit-Subject Field Code, while the last row shows combined figures for all Organizational Unit-Subject Field Codes for a particular Room Type. The interesection of this last row and column shows total number of rooms, NASF, etc. for the building.

A listing of <u>Non-assignable Area by Room Type</u> follows the matrix, and this combination of matrix and listing continues for every building on campus.

The second matrix is the same as the first except that the figures are carried to the campus level and the Non-assignable Area listing is omitted. The third matrix also follows the format of the first except that it details Room Type (110, 199, etc.) and leaves general the Organiza-

The fourth matrix classifies Campus-wide General Room Types against General Organizational Units. Each cell contains only the number of rooms and the NASF. The matrix is followed by the Non-assignable Area Listing. These data satisfy the requirements of the 1970 - 1971 HEGIS form 2300-7, Part B.

The fifth matrix - Data Breakdown by Type of School versus Degree of Graduate Program - first lists all existing school types (engineering, dental, etc.) in rows and then degrees of graduate program in columns. Each cell contains the number of buildings that satisfy matrix requirements and their combined NASF, while the last column shows the total of all degrees of graduate program for each type of school. The last row contains totals of all types of schools for each degree of graduate program, and the intersection of this row and column shows combined totals on campus. Following this matrix is a Listing of Area Devoted to Graduate Use and Percentage of Campus Total Assignable Area by type of school, graduate area, and percent of total campus area. Campus area devoted to graduate use is approximated by multiplying total areas of the columns for each row by the mean of the domain (1-9% = 5%, 10 - 24% = 17%, etc.) to obtain a weighted figure.

Five additional, detailed listings complete the Campus Level - Part II printout. The first is a building-by-building listing that relates NASF to Gross Area, Gross Area to Campus Total Gross Area, and Gross Research Area to Campus Total Gross Area. This section is followed by a detailed campus-wide listing of every room type (including Non-assignable Area) and its corresponding total NASF.

The third listing shows campus-wide totals of Gross Area, NASF, and the ratio between them; relates construction types to number of buildings, Gross Area, and decade of construction; and gives data about scheduled demolition including dates, number of buildings, and gross areas affected. The fourth listing gives financial data that include total costs of building and equipment, estimated value of buildings, sources of funds, number of sources, amounts provided by each source for every building, ownership codes, and the number of buildings, gross area, and value co rresponding to each code.

The fifth and final listing of the Campus Level - Part II printout shows total institutional enrollment and NASF per student, based on total academic and auxiliary space.

State Level - Part I: Listing Summaries

The first page of this printout lists each type of institution according to federal codes for highest level of degree offered and type of program available. Each type of institution in this column is followed by a row of figures indicating its total Gross Area, total owned Gross Area, total Gross Area by type of ownership, and total Gross Area shared with other institutions of various kinds. At the bottom of the page these figures are summarized for all institutions of higher education in the state of Massachusetts. The final row on this page shows total Gross Areas constructed during each of the past five decades and before 1919.

Pages two and three list NASF for every Room Type. NASF progressively is broken down by broad categories of use, general Room Type, and detailed Room Type. Non-assignable and Unassigned Areas appear at the end of this section.

The next four pages list NASF by Organizational Unit-Subject Field Code. Again, NASF is broken down by stages - first by Organizational Unit, then by broad Subject Field category, and finally by specific Subject Field Code. Here, also, Non-assignable and Unassigned Areas appear at the end. A listing of NASF for each detailed Room Type appears next and is followed by figures showing State-wide Gross Area, State-wide NASF, and their ratio.

The State-wide Financial Data on the following page include totals for building costs, equipment costs, and estimated value of buildings. For buildings first occupied after June 30, 1958, they show sources of funds as well as number of buildings funded and total amount supplied by

each source. For each type of ownership, the <u>State-wide Ownership</u> <u>Listing</u> displays number of buildings owned, their total value, and their Gross Area. Finally, <u>State Enrollment Figures</u> provide the total fall of 1968 enrollment according to the Board of Higher Education of Massachusetts the ratio of NASF to enrollment, and the standard deviation for that ratio.

State Level - Part II: Matrix Summaries

The first matrix breaks down institutional categories by the highest level of training offered versus the type of program provided. Each cell shows the number of schools that satisfy the cell's requirements, their combined NASF, and a weighted area figure (cell's % of state NASF/cell's % of number of institutions in the state). The fourth entry in each cell is a weighted enrollment figure (cell's % of state enrollment/cell's % of number of institutions in the state), and the fifth entry is a weighted NASF per student ratio carried forward from the campus to the state level (cell's % of state NASF/cell's % of state enrollment). The sixth and last figure represents NASF per student. Total Gross Areas for each category (I through V) appear in the last column and totals for each category (A through K) in the last row.

The second matrix - State-wide Data Breakdown by Organizational Unit-Subject Field Code (detailed) versus Room Type - uses general Room Type codes like 100, 200, etc. Each cell shows the number of rooms meeting cell requirements, their NASF, their NASF as a percentage of state NASF, their number of stations, their NASF per station, and the standard deviation for that ratio. The last column contains total NASF for each Organizational Unit-Subject Field Code listed, and the last row displays total NASF for each general Room Type. The intersection of this row and column shows total NASF for all Room Types and Organizational Unit-Subject Field Codes.

The third matrix follows the format of the second one, but it

shows Room Type (detailed) versus Organizational Unit-Subject Field
Code using general Organizational Unit codes like 1000, 2000, etc.
The types of information shown are identical with those of matrix
two, and at the intersection of the last row (total NASF for Organiza-
tional Units) and the last column (total NASF for Room Types), the
figures themselves are identical.

The fourth matrix, which simplifies the second and third ones, depicts
Room Types versus Organizational Units using the general forms of
both categories. The cells contain only two figures: one for the number
of rooms meeting cell requirements and one for the combined NASF of
this number. This matrix easily can be transposed onto the HEGIS form
2300-7. It is followed by a state-wide listing of Non-assignable Area by
Room Type.

Both the fifth section - State-wide Data Breakdown by Type of School
versus Degree of Graduate Program - and the sixth one - State-wide
Listing of Area Devoted to Graduate Use and Percentage of State Total
Assignable Area - carry to the state level the format of the parallel
campus level matrix and listing (see p. 15).

Except for the last one, all of the following matrices relate to various
aspects of construction. In the sixth matrix - State-wide Data Breakdown
by Construction Decade versus Type of Construction - each cell contains
the number of buildings that meet cell requirements, their Gross Area,
the ratio of their NASF to that area, the standard deviation of that
ratio, and the percentage of Gross Area renovated. The last columns
show totals of all construction types for each decade. The last row

contains totals of all decades for each construction type, and the cell at which this row and column intersect displays total numbers of buildings for all types of construction and all construction decades, their total Gross Area, the ratio of their total NASF to that area, the standard deviation of that ratio, and the percentage of Gross Area that has undergone renovation. Matrix seven differs from this one only in that types of construction in the columns are replaced by condition codes; and matrix eight departs from the seventh one only by changing construction decades to renovation decades and necessarily eliminating the cell entry for percentage of Gross Area renovated.

The succeeding series of matrices shows type of construction versus condition for each of the past six decades, beginning with 1908-1917. Each cell in this series follows the format of the first construction matrix. The next matrix summarizes the preceding series, showing type of construction versus condition for all decades.

The last matrix - Enrollment versus Type of Institution - shows four levels of enrollment against types of institutions categorized both by the federal code for the highest level of degree offered and by their public or private status. Each cell shows the number of students, the NASF per student, and the standard deviation for that ratio. The last column shows totals of all categories at each enrollment level, and the last row provides totals of all enrollment levels for each category of institution. The figures in the cell at their intersection are for the whole state, irrespective of institutional category or level of enrollment.

State Level - Part III: Correlation Studies

Correlations were developed for four groups of studies. The first and largest of these concerned construction and renovation; it used a series of correlations in attempting to show the patterns of construction, renovation, and demolition of buildings according to their respective mean years.

The first correlation - Date of Construction versus Year To Be Demolished - typifies many others in the study. This correlation shows average year of construction against average year of demolition for all buildings scheduled to be demolished. It gives the number of points (buildings) used, the x-mean (mean-year of construction), and the y-mean (year of demolition), followed by the x standard deviation and the·y standard deviation. Following this basic information are three more figures - the correlation coefficient, the standard error of estimate, and the regression coefficient. These allow computation of the accuracy of the basic information. All six sets of information are supplied for all of the following correlations.

Correlations of Date of Construction versus Year To Be Demolished were performed for both renovated and unrenovated buildings; each attempts to show the mean year of construction against the mean year of scheduled demolition for each type of structure. Together they show the life span of renovated versus that of unrenovated buildings.

For renovated buildings, a fourth correlation shows mean year of construction versus mean year of renovation, and a fifth shows

mean year of scheduled demolition versus mean year of renovation. A Listing of Renovated and Unrenovated Buildings shows for buildings in those two categories the percentage of buildings constructed in various ways (wood, masonry, concrete, etc.), the percentage in various states of repair (ranging from "satisfactory" to "should be razed"), and the percentage scheduled for demolition. A matrix - Year To Be Demolished versus Renovated and Unrenovated Buildings - plots the data contained in the preceding correlations. It shows categories by Renovated and Unrenovated Buildings against the years in which they are scheduled for demolition, from 1969 through 1983. The information in each cell shows the number of buildings that conform to the cells' requirements, their Gross Area, average year of construction, and standard deviation.

Gross Area Studies rely on four correlations that attempt to show trends in the amount of academic and auxiliary areas renovated in the past fifteen years and scheduled for demolition in the next fifteen years. The first correlation shows the x mean as the average year of renovation and the y mean as the average academic area renovated per year in the past fifteen years. The second correlation shows the same information for auxiliary area. Correlations three and four show the average area of demolition per year scheduled for academic area over the next fifteen years and the same information for auxiliary area.

The series of correlations that support Financial Studies first attempts to show how Gross Area relates to cost per square foot and then tries to depict the changing costs of construction for academic

and auxiliary area over the years. The first correlation plots the average Gross Area per building against the cost per square foot for construction of academic area, and the second does the same for auxiliary area. Correlations three and four show, for buildings constructed between 1930 and 1939, the average year of construction versus the average cost per square foot of academic and auxiliary area respectively. These correlations are repeated for the succeeding decades.

Three correlations are used for Gross Area per Student Studies. They show mean Gross Area of academic space per student during the past twenty-two years, mean Gross Area in the state during the past twenty-two years, and mean enrollment during the same period.

The growth of higher education facilities increased last year.   An

increase in the completion of new buildings and a decrease in the demoli-

tion of old buildings combined to increase the growth of assignable space

by one fourth.   At the same time, the lower rate of demolition of older

buildings slowed last year's marked decline in less efficient, non-assign-

able area.   These changes, by room classification, follow:

Change in Facilities by Room Classification

Facilities	Increase in NASF (millions)	1970 Percent	1971 Percent	1972 Percent
Assignable Area	2.4	7%	4%	5%
Academic Area	1.9	9	3	8
100 Classrooms	.1	6	3	4
200 Laboratories	.3	5	3	5
300 Offices	.4	4	5	7
400 Study Facilities	1.0	11	3	34
500 Special	.0	19	15	15
700 Support	.1	5	1	2
Auxiliary Support	.5	6	6	3
600 General	.1	5	3	2
900 Residential	.4	6	7	2
Other (including 800)		8	10	

Organizing this data by activity:

Activity	Increase in NASF (millions)	Percent
Academic Activities	.92	5
1000 Departments	.64	5
2000 Organized Activities Units	.03	6
3000 Organized Research Units	.09	8
4000 Public Service	.00	0
5000 Libraries	.16	6
Auxiliary Activities	1.71	6
6000 General Administration	.82	23
7000 Auxiliary Services	.91	4
8000 Noninstitutional Agencies	-.02	-2

Activity	Existing Ratio	Construction Ratio*
Academic Activities	.25	.35
1000 Departments	.19	.24
2000 Organized Activities	.00	.01
3000 Organized Research	.01	.03
4000 Public Service	.00	.00
5000 Libraries	.04	.06
Auxiliary Activities	.36	.66
6000 General Administration	.05	.31
7000 Auxiliary Services	.31	.35
8000 Noninstitutional Agencies	.00	.00

*Base for ratios: gross area and increase in gross area. Demolition figures, unassigned, and nonassignable figures were excluded.

Academic activities of all types are receiving increasing emphasis with the exception of public service NASF. Particularly important is the large increase in departmental NASF, reversing the reduction of last year for this category. The organized departments and libraries still have the greatest absolute growth in area, but the rapid increase in library space of last year has been moderated. Auxiliary space has continued to increase as the increase in general administration space has more than counterbalanced the decrease in noninstitutional space.

A DESCRIPTION OF THE FIPS COMPUTER SYSTEM

INTRODUCTION

Five separate programs comprise the Facility Inventory Project System, (FIPS), two programs in Phase I, three in Phase II. The programs are as follows:

PHASE I

        EDIT

        UPDATE

PHASE II

        LISTING

        MATRICES

        PLOTS

The Phase I programs are used to bring new data into the system and produce a new master file. This file is, in turn, input to each of the Phase II programs. The following diagram shows the relationship between the five programs, and the data files that serve as input and output to each.

The new master file will, in turn, become the old master file when it is desired to make corrections to it, and another new master file will be produced.

THE FIVE PROGRAMS

Edit:

The edit program reads in the correction cards, validates the data, and produces a tape that will serve as input to the update program. This tape is referred to as the transaction file. It also creates two lists. The first is a list of the cards that it found to be in error. These cards will be listed in the same format and in the same order as they appeared in the deck of correction cards. An asterisk beneath a field indicates that it is in error (the data itself is incorrect, or is misplaced within the field), and the letter M indicates that that field is missing. The user should examine this list and decide if these cards should be corrected and the edit program re-run. A card that has missing fields, but no field in error, will not show up in this list.

The second list shows the new data as it will appear on the master file. The data has been sorted so the records appear in the order of ascending institution, ascending building number within institution, and room sequence within each building. The edit assigns new rooms sequence number 9999, so that they appear at the end of each building. (The update program will assign them more appropriate sequence numbers). This list, saved from each run of Phase I, can serve as a permanent record of changes made to the master file. The format of these records differs from that of the correction card, and

is, instead, in the format used internally by the program. See Appendices A-1
and A-2 for the correction card format and the internal format. The records
for cards that the Edit Program found in error do not appear in this listing
exactly as they will appear on the master file. The Edit program has
added a 1 to the left-most position of numeric fields of room records to
indicate to the update program that these fields were in error. Building
characteristic records are followed by a sequence 3 record to indicate
errors. It should be noted that the introduction of two building cards for
the same building, or two buildings with the same building number, will
cause later reports to be inaccurate. It is suggested, therefore, that
the user peruse this list of records carefully, and verify that no such
duplicates exist.

The Edit Program actually consists of 3 programs. The first, and largest
performs the editing function. A second job step calls upon the standard
360 OS soft package to sort the data records. The third job step lists the
sorted records. This third program is written in Utility Coder, a CCA
proprietary program.

Update Program:

The Update Program uses the output tape of the edit program and corrects
the old master file, creating a new one. Rooms, buildings, and institutions
are appropriately added, deleted, or replaced. An option card, set up by

the user, controls the program's operation. The format of the card is
as follows:

Column 5   M indicates that there will be a master file for
             this run

Column 6   T indicates that there is a transaction file

Column 7   R indicates that there will be a state summary report

Column 8-15 The date in the following format: 09/22/70

In almost all cases, there will be both a master file and a transaction file.
If, however, the user wants to start from scratch, i.e., he does not intend
to update his current master file, but wishes instead to create a new one,
entirely from cards, then he will use the edit program to produce the trans-
action file, and run the update without a master file. If the user would
like to produce a report, but does not want to correct the master file, he
would just run the update program with his master file and without a trans-
action file.

A report will be printed for each institution for which an institution record
exists on the transaction file, i.e., for each institution card submitted
to the edit program. The state summary report will be produced only
if an "R" appears in column 7 of the option card.

The Plot, Listing and Matrix Programs:

These programs produce the graphs and reports described in the Document

"Derived Data Projections". They use the newest master file as input, and can be run in any order.

The Plot Program produces visual displays and statistical analyses of correlations on the state level. Year of construction, demolition, and renovation of the building in the state are compared to cost and size in various combinations.

The Listing program creates lists of data on building, campus, and state levels. These lists concern gross, assignable, and research area, as well as construction and financial information.

The Matrix Program displays building, campus, and state wide correlations in table format. The data dealt with in this fashion include utilization, construction, financial, and enrollment information. Also created by the Matrix Program is a table for each school that can be copied directly onto the Hegis Form.

RUNNING THE PROGRAMS

Job control cards are placed at the beginning and end of a program that serve to describe to the computer the type of program to be run and the various input and output files. These cards are installation dependent, i. e., they will have to be changed if the program is to be run on a diff-

erent computer. All five programs require that the computer be equipped
to handle Fortran IV, level G. The largest of the five, the Matrix Program,
requires 316 K core. The Plot Program makes use of the SC 4020 Plotter, a
feature of the Avco installation. The production of the full list of all
correction records by the edit program, requires that computer have access
to Utility Coder, a requirement fulfilled by Phillip Hankins but not by Avco.
The Edit Program is now set up to run at Phillip Hankins, and the remaining
four programs at Avco. The Avco programs are set up to produce four
part printed output.

In setting up the program to run, the user is concerned with two matters.
They are described separately below.

1.   The placement of the data cards in the program deck. The user's
        correction cards are input to the edit program, and should be placed
        between the two red cards. If there are many correction cards,
        the last part of the program deck may be put into another box.
        Be sure to number the boxes to indicate to the operator the order in
        which the boxes are to be read. The first box should contain the
        first part of the program deck (up to and including the first red
        card), and as many correction cards as will fit. As many boxes as
        necessary to contain the remaining correction cards, and the last
        box ends with the remainder of the program deck (from the second red
        card on).

The update program requires the option card described above. It should be placed between the two red cards at the end of the program.

2. The job control cards are adjusted to reflect changes in the tapes used as input and output. Each time the system is run, such changes are likely to occur. The new master file will probably become the old master file for the update program, and a new master file produced. It is this tape that will be used to run the Phase II programs. The job control cards that may have to be changed appear near the end of each deck and are blue. The particular field on that card that may be changed is the six characters that follow the words VOL-SER-. The six alphanumeric characters that are put in that space usually appear written on the outside of the tape itself. There is one of these cards in each program for each tape that will be used as input or output. The blue cards in each program refer to:

Edit Program

       1st blue card--the transaction tape

       2nd blue card--the transaction tape

Update

       1st blue card--the transaction tape

       2nd blue card--the old master tape

       3rd blue card--the new master tape
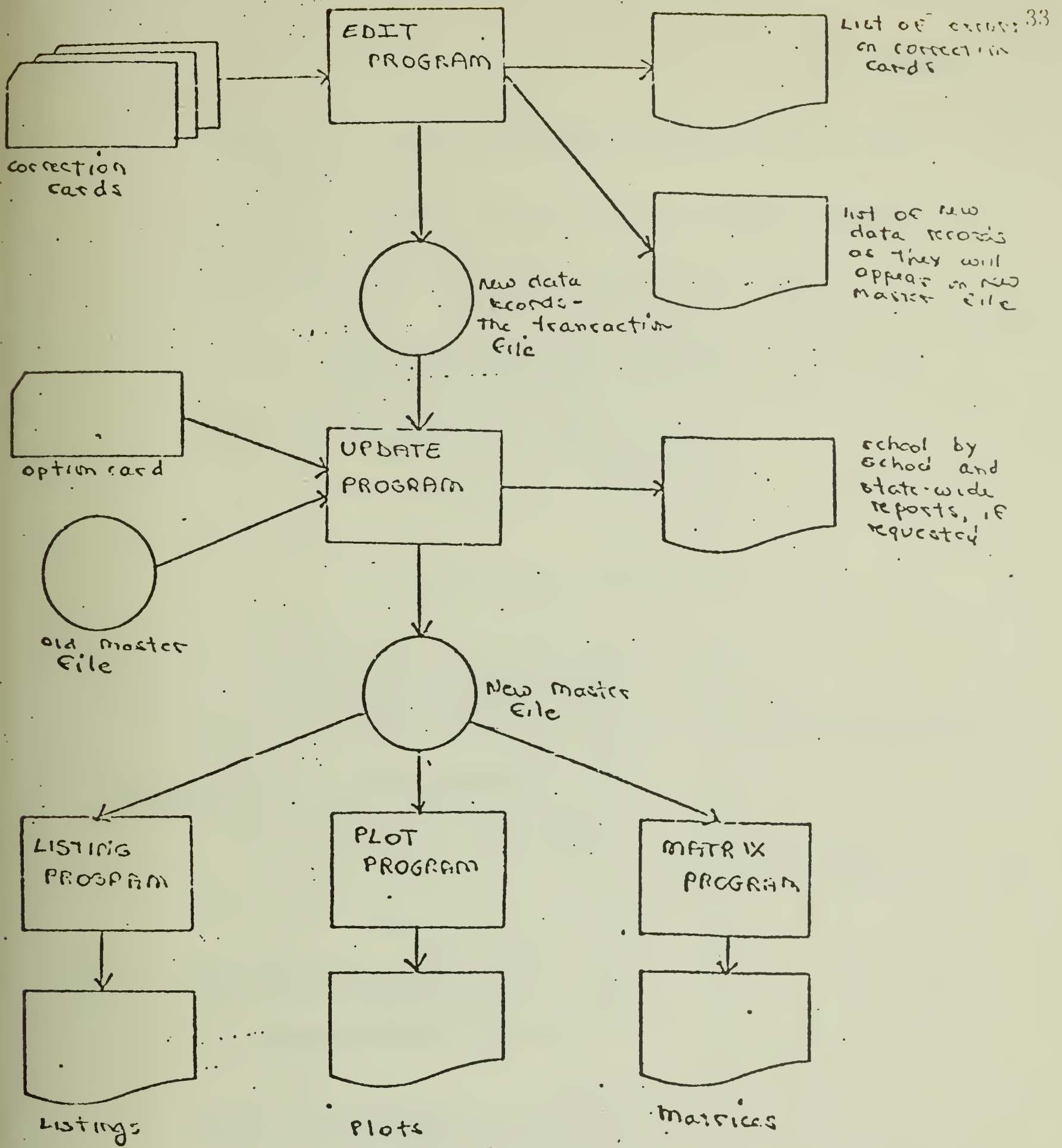
Plot

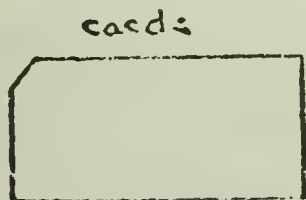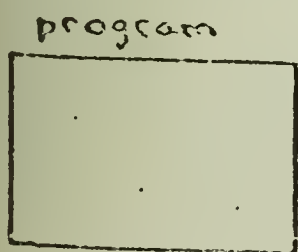   the new master tape

Listing

    the new master tape

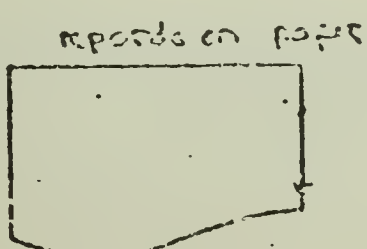Matrix

    the new master tape

The user having set up the decks as described above, will contact

the appropriate computer installation. He will have to fill out

a form to run the program, and can receive help in doing this at

the installation.

EDIT
PROGRAM

correction
cards

List of errors 33
on correction
cards

list of new
data records
as they will
appear on new
master file

New data
records -
the transaction
file

UPDATE
PROGRAM

option card

old master
file

school by
school and
state-wide
reports, if
requested

New master
file

LISTING
PROGRAM

PLOT
PROGRAM

MATRIX
PROGRAM

Listings

Plots

matrices

KEY:

program

cards

arrow into a program
indicates input

arrow out of program
indicates output

tape

reports on paper

APPENDIX B

AN OUTLINE OF THE FIPS COMPUTER OUTPUT DATA

I. CAMPUS LEVEL--PART I--INPUT LISTING

   A. For every building in use, the following information will be found for that building:

   1. The institution number and name

   2. Institution type (Federally designated codes: I--V for highest level offering and A--K for type of program)

   3. Enrollment

   4. The building number and name

   5. Under Function
      (a) Ownership code (1--8, owned, leased, etc.)
      (b) Degree of graduate program (1--6, where 1 is none, 2 is 1%--9%, etc., through 6 is 75%--100%)
      (c) Type of school (1--20 is any of a number of professional schools this building serves)
      (d) location

   6. Under History
      (a) Year initially occupied
      (b) Year constructed
      (c) Year of the most recent rehabilitation and/or modernization
      (d) Year scheduled to be demolished

   7. Under Design
      (a) Type of construction (1--9, wood frame, reinforced concrete, etc.)
      (b) Number of floors
      (c) Condition (1--5, "satisfactory" to "should be razed," etc.)
      (d) Fallout shelter (1--4, as a description of the building in a national shelter survey)
      (e) Percent air-cooled (1--6, where 1 is none through 6 is 75%--100%)

   8. Under Investment
      (a) Cost of the building
      (b) Cost of the equipment
      (c) Estimated insurable value of building

9. Gross Area

10. Under Sources of Funds

   (a) Sources of funds (1-20 it includes sources from government, appropriations, taxes, foundations, loans, etc.)
   (b) The amount of the Fund. This will be repeated if more than one source is involved.

B.   Room by Room Inventory For The Building

   1. Room Number

   2. Under Organizational Unit:

      (a) Institutional name of unit
      (b) Institutional code (for institution's use)
      (c) Organizational unit - Subject-Field Code (1110-9083)

   3. Under Room Type

      (a) Institutional name of room
      (b) Room Type (110-999 and non-assignable codes)

   4. Number of Stations

   5. Net Assignable Area

   6. Percentage Research

C.   Total Net Assignable Area For Building.

D.   After Last Building, Total NASF for Institution

II.   CAMPUS LEVEL - PART II - MATRIX

A.   For Every Building:

   1. Data breakdown by organization and subject-field codes (Detailed 1110 - 9083) versus Room Type (general 100-900)

    2. Each cell contains:

       (a) Number of rooms
       (b) Room NASF
       (c) Percent room NASF/building NASF
       (d) Number of stations
       (e) Room NASF/stations
       (f) percent research

    3. Followed by Non-Assignable Area listing by Room type (10-40)

B.   Same as above but carried to campus level with non-assignable area omitted

C.   For every building:

    1. Data breakdown by room-type (detailed 110-999) versus organizational unit and subject-field code (1000-9000)

    2. Every cell contains same information as matrix A.

D.   HEGIS Matrix · Campus level general Room Type vs. Organizational Unit, with each cell containing no. of rooms and NASF followed by non-assignable listings.

E.   Data Breakdown by Type of School (1-20) versus Degree of Graduate Program (%) Each Cell Contains

    1. Number of buildings, and

    2. Combined NASF, followed below by:

    3. Listing of type of school

    4. Graduate area

    5. % of total campus area

F.   Building by Building Listing of:

    1. Ratio of NASF to gross area

    2. Gross area and % of campus total

    3. Campus wide listing of area by room type

G.   Construction Data:

    1.   Total Gross Area

    2.   Total NASF

    3.   NASF to Gross Area Ratio

    4.   Listing of contruction type with number of buildings
and combined Gross Areas

    5.   Listing construction by decade, number of buildings,
and Gross Areas

    6.   Scheduled year of demolition, number of buildings,
and Gross Area with total Gross Area to be demolished
cost.

H.   Financial Data:

    1.   Total building costs

    2.   Equipment costs

    3.   Estimated value of buildings

    4.   Sources of funds listing, number of them, and combined
amounts

    5.   Ownership codes listing, number of buildings, Gross Area,
and value of each

I.   Enrollment Data:

    1.   Total enrollment

    2.   NASF/student

III. STATE SUMMARIES - PART I - LISTING

A.   Institutional Gross Areas by Federal institutional codes
(I-II, A-K) and ownership code.

B.   Gross Area of construction by decade

C.   Assignable area detailed by Organizational Unit and Subject Field codes

D.   Assignable area detailed by Room-Type

E.   Statewide Gross Area, NASF, and NASF/Gross Area

F.   Financial data:

      1. Cost of buildings, cost of equipment, and present estimated value of building

      2. Sources of funds, number of buildings, and amount

G.   Ownership listing by number of buildings, amount and Gross Area

H.   State enrollment, State NASF/state enrollment, standard deviation of that ratio

IV.   STATE SUMMARIES - PART II - MATRIX PROGRAM

A.   Data breakdown by institutional code (I-V) versus type of program codes (a-k). Each cell contains:

      1. Number of schools

      2. NASF

      3. That NASF as a percentage of State NASF/number of schools as a percentage of the total number of schools

      4. Percent of state enrollment/percent of total number of schools

      5. Percent of state area/percent of state enrollment

      6. NASF/student

B.   Detailed Organizational-Unit Subject Field Code (1110-9083) versus general Room-Type (100-900). Each cell contains:

B. (continued)

    1. Number of rooms

    2. NASF

    3. NASF/state NASF

    4. Number of stations

    5. NASF/station

    6. Standard deviation of NASF/station

C. Detailed Room-Type (110-999) versus general Organizational-Unit Subject Field code. (1000-9000). Each cell contains the same information as Matrix 3.

D. Statewide HEGIS Matrix: General Room-Type versus general Organizational-Unit, contains only the number of rooms and the NASF in each cell followed by Non-Assignable listing.

E. "Data" Breakdown by type of school versus degree of graduate program" and "Statewide listing of area devoted to graduate use and percentage of state total NASF" are same format as on state level.

F. State wide date breakdown by construction decade versus type of construction. Each cell contains:

    1. Number of buildings

    2. Gross Area

    3. NASF/Gross Area

    4. Standard deviation of NASF/Gross Area

    5. Percent renovated

G. "Condition versus type of construction" follows same format as above

H. "Condition versus last decade of renovation" follows same format as above

I. Series of matrices by decade of construction beginning 1908 shows condition versus types of construction and follows same format as above.

J. Summary matrix of I with all decades combined

K. Institutional codes (I-V) and public or private versus enrollment. Each cell contains:

   1. Number of schools

   2. NASF/student

   3. Standard deviation of NASF/student

V. STATE SUMMARIES   PART III - CORRELATIONS

A. Correlations:

   1. Date of construction versus year to be demolished

   2. Date of construction versus year to be demolished for non-renovated buildings

   3. Date of construction versus year to be demolished for renovated buildings

   4. Date of construction versus year to be renovated

   5. Date of renovation versus year to be demolished

                    All correlation studies contain:

                        a. the number of points used,
                        b. the x-mean,
                        c. the y-mean,
                        d. correlation coefficient,
                        e. standard error of estimation, and
                        f. regression coefficient

B.   Listing of percentage of buildings renovated by:

           1.   Type of construction

           2.   Condition

           3.   Percentage to be demolished

C.   Listing of percentage of buildings non-renovated follows same format as above

D.   The year to be demolished versus renovated and non-renovated

E.   Correlations:

           1.   Gross Area-Academic, renovated past 15 years

           2.   Gross Area-Auxiliary, renovated past 15 years

           3.   Gross Area-Academic, to be razed next 15 years

           4.   Gross Area Auxiliary to be razed next 15 years

F.   Financial studies: Correlations:

           1.   Gross Area versus cost/sq. ft., academic

           2.   Gross Area versus cost/sq. ft., auxiliary

           3.   Year to be constructed versus cost/sq. ft., academic

           4.   Year to be constructed versus cost/sq. ft., auxiliary

G.   Gross Area per student studies:

           1.   Gross Area per student past 22 years, academic

           2.   Gross Area past 22 years, academic

           3.   Enrollment past 22 years

EDUCATIONAL MANAGEMENT ASSOCIATES

February 16, 1973

MEMORANDUM

To: Institutional Representatives for 1972
      Facilities Inventory Update

From: Donald M. Levine, Director
       Facilities Inventory Project

Subject: Updating Requirements for the Facilities Inventory and Higher Education
        General Information Survey (HEGIS)--Inventory of College and University
        Physical Facilities

      The Facilities Inventory Project will now begin an update of the data concerning your college's physical facilities. This update will allow us to prepare materials for you during the coming year as well as organize the required information for the 1972 HEGIS Form on physical facilities.

      This year's Update of the 1971 Facilities Inventory must reflect physical facilities in use as of September 30, 1972. Any changes that have occurred since the 1971 Facilities Inventory or errors contained in that printout will necessitate using the enclosed Update Forms. The following list documents changes in your situation which will require the use of the Update Forms:

1.   Any new buildings that have been constructed or leased since September 30, 1971 (cut-off date for the 1971 Facilities Inventory);

2.   Any buildings that have been demolished or are no longer leased since the original inventory;

3.   Any renovation that has occurred that changes the uses and/or sizes of rooms and/or buildings;

4.   Any changes in the use of a room or changes from unused to used space;

5.   Any errors that were found in the last printout.

Thus this Update will account for all changes that have occurred since September 30, 1971 and will reflect the description of your college's physical facilities as of September 30, 1972. We do not anticipate that the job of providing this information will be very difficult. The major task of providing the foundation inventory has been completed. In order to prepare the submissions for the physical facilities portion of the HEGIS material, we need to have your Update Forms in this Office no later than April 1, 1973. This will allow us sufficient time to process the data and return to you for your verification before it is sent to the appropriate agency for final submission by your college

We have enclosed Update Forms for your use as well as a short instruction sheet. We will of course be glad to answer any questions that you might have in completing these forms. If any problem arises, our new address is 30 Beacon Street, Somerville, Massachusetts 02143. Our telephone numbers are: (617) 868-6820 and 868-6821. I look forward once again to your participation in the Inventory and will attempt to insure that our service to you and the Commission will be of value.

DML:ww
Enclosures: Update Forms and Instructions

EDUCATIONAL MANAGEMENT ASSOCIATES

8 PLYMPTON STREET   CAMBRIDGE, MASSACHUSETTS 02138

SUITE 43   617-868-6820

February 16, 1973

INSTRUCTIONS FOR 1972 FACILITIES AND HEGIS UPDATE

Please note that this is an update only. You are required to reflect changes as they may have occurred since the last printout (reflecting conditions as of September 30, 1971). The present Update will show conditions as of September 30, 1972. This Update is due in the Office of the Facilities Inventory Project, 30 Beacon Street, Somerville, Massachusetts 02143 on April 1. 1973.

The Update Forms are to be used for five classifications of changes:

1. Any new buildings that have been constructed or leased;

2. Any buildings that have been demolished or are no longer leased;

3. Any renovation that has occurred that changes the uses and/or sizes of rooms and/or buildings;

4. Any changes in the use of a room or changes from unused to used space;

5. Any errors that were found in the last printout.

These changes can be updated by the use of one or more of the enclosed Update Forms. There are four Update Forms which are listed below:

1. Building Characteristic Sheet
2. Room-By-Room Facilities Inventory Form
3. Room-By-Room Facilities Inventory Form (CORRECTION FORM)
4. Deletion Form

These forms are used in the following situations:

1.   The Building Characteristic Sheet should be used along with the supporting Room-By-Room Facilities Inventory Form for any new buildings constructed or leased since September 30, 1971 and in use as of September 30, 1972. All codes and definitions for filling up these two forms (the Building Characteristic Sheet and the Room-By-Room Facilities Inventory Form) remain the same. Please consult your Facilities Inventory Project Manual for instructions regarding these forms.

2.   The Deletion Form is to be used for any building(s) in the original inventory that are no longer in use by the institution through either demolition or termination of lease. Use of the Deletion Form on a building which has been demolished or terminated will also erase all the rooms in that building. The Deletion Form can also be used to delete a single room. However, the Deletion Form should only be used to delete a single room if no entry is going to replace it. If an entry is going to replace the room deleted, it is possible to use the Room-By-Room Facilities Inventory Form (CORRECTION FORM) which will write over the original entry because the sequence number will be identical for both the old and new entry.

3.   Renovation or alteration in one or a group of rooms and/or a building such that the original inventory classifications are no longer valid may require the use of a Building Characteristic Sheet entry, a Deletion Form entry, and a Room-By-Room Facilities Inventory Form(CORRECTION FORM) entry. For example, if a room or rooms were renovated, the changes would be indicated on a Room-By-Room Facilities Inventory Form(CORRECTION FORM). If the renovations resulted in a change in gross square footage, for example, it would be necessary to change the total entry for the building as well. Thus an entry would have to be made on a Building Characteristic Sheet. Such an entry would erase the original entry and create a new one. Further the renovation of a building might involve the removal of a room presently listed in the inventory. An entry would therefore have to be made on the Deletion Form.

Note: It is possible to also add room entries which are entirely new(without sequence numbers) on to the Room-By-Room Facilities Inventory Form(CORRECTION FORM) for purposes of keeping all room changes and additions together on one form.

Thus you would list first all rooms which had had changes and then rooms which were added on. These rooms which were added on would have no sequence number since they would not be in the listing which you received from the Facilities Inventory Project Office.

4.   The Room-By-Room Facilities Inventory Form (CORRECTION FORM) is used if a room or rooms have changed departments or use or have changed from unused space to used space.

5.   If there were errors either in coding, assignable area, duplications, etc. in the last printout, they can be corrected by using the Room-By-Room Facilities Inventory Form (CORRECTION FORM), or Building Characteristic Sheet, or Deletion Form or some combination of these depending on the individual case.

Some further notes on the use of the Deletion Form and the Room-By-Room Facilities Inventory Form (CORRECTION FORM):

DELETION FORM: To delete a room: if a room in the printout has been duplicated or does not exist, it is deleted. First, fill in the name of the institution, then the institution number followed by the number of the building which has the room. This is followed by a sequence number which appears on the printout under the name, followed by filling in a "D" under 79(D) in the Deletion Form. This insures that the deletion will occur for the room indicated alone. In the last column fill in an "R" to denote that a room (and not a building) has been deleted.

To delete a building: If a building on the original inventory is no longer used by the institution, it is deleted. The procedure is the same as a room deletion with the exception of the final column. Fill in the institution name, institution number, building number, ignore the sequence number (leave blank), fill in "D" and then "B" for deleting a building.

Room-By-Room Facilities Inventory Form
(CORRECTION FORM):

It is completed in the same way as the regular
Room-By-Room Facilities Inventory Form except
that the last column has a sequence number. If a
room has changed in any way or was wrong in the
printout, fill in all columns making the corrections
and add the sequence number that is on the printout
so that the new entry you have just made will
replace the older information concerning the room.

Please note that it is not necessary to begin a fresh form for each set of deletions
or corrections. So long as care is taken to insure that the correct sequence
numbers are indicated in each case, it is possible to list all deletions and
corrections respectively in a continuous fashion. However you must be sure to
use only the Deletion Form for deletions (entries which will be taken out and not
replaced) and the Room-By-Room Facilities Inventory Form (CORRECTION FORM)
for corrections (entries which will replace entries which are presently listed on
the printout). New Buildings and their room entries should be kept together as a
group. Finally, this Office will be glad to supply you with more forms if you need
them and will also be glad to answer any questions you may have about the
material. The data you enter should reflect conditions which will apply on
September 30, 1972 and it should be turned in to this Office on or before April 1, 1973.

The address and telephone number of the Project is as follows:

FACILITIES INVENTORY PROJECT
30 Beacon Street
Somerville, Massachusetts 02143

Telephone: (617) 868-6820 or 868-6821

NOTE: Before entering any alterations in the data, you should begin by
examining your printout which will describe the entries which we
currently have in our data file for your college. In some cases,
some alterations are already made in our file and are reflected in
your printout as a result of information received shortly after the
official close of the Facilities Inventory. The important thing is
that after examining your printout and completing the Update Forms
we should then have an accurate picture of your facilities as of
9/30/72.